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# A STUDY OF SPOTTED OWL DEMOGRAPHICS IN THE SIERRA NATIONAL FOREST AND SEQUOIA AND KINGS CANYON NATIONAL PARKS

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# A STUDY OF SPOTTED OWL DEMOGRAPHICS IN THE SIERRA NATIONAL FOREST AND SEQUOIA AND KINGS CANYON NATIONAL PARKS

by

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## INTRODUCTION

This report summarizes key activities and preliminary results of demographic studies of California spotted owls (*Strix occidentalis occidentalis*) in the Sierra National Forest and the Sequoia and Kings Canyon National Parks for 1996. Demographic studies were initiated in March of 1990. Information collected will allow comparisons between spotted owl demographics in a managed National Forest and protected forests of the National Park. In 1994 an additional study area was initiated in Sierra National Forest to provide complete coverage of the Kings River Ecological Management area. Results from all study areas are provided in this report. All tables and figures have been updated to reflect the current analysis of data for all years (1990-1996). This report supersedes all previous annual reports. Data contained herein are preliminary and permission to publish any of the contents of the report is therefore withheld pending specific authorization.

## OBJECTIVES

1. Estimate densities of spotted owls and occupancy status of owl territories in the designated study areas.
2. Estimate vital rates (reproduction, mortality) by age class.
3. Assess site fidelity among individual spotted owls.
4. Estimate the number of missing and replaced spotted owls.
5. Quantify the distribution of habitats within the study areas.
6. Characterize diets of spotted owls from regurgitated pellets, and compare diets of breeding and nonbreeding pairs during the breeding period (1 March to 30 September).

## STUDY AREAS

Boundaries of study areas were delineated on major topographic features such as ridges, drainages (major rivers), and administrative boundaries (e.g., Sequoia and Kings Canyon National Parks boundaries). The Sierra National Forest study area (SNF) covers 161 $mi^2$, the New Sierra study area (NS) covers 103 $mi^2$ and the Sequoia and Kings Canyon National Parks study area (SNP) covers 130 $mi^2$ (Fig. 1). Three vegetation zones, oak woodland (1,000 to 4,000 feet), mid-elevation coniferous forest( 4,000 to 8,000 feet) and high elevation coniferous forest (8,000 to 9,600 feet) are found in all study areas. A detailed description of these vegetation types and the area they occupy for the SNF and SNP can be found in the 1990 annual report (Verner et al. 1990). For the NS study area, oak woodland encompasses 11 $mi^2$ (28 $km^2$), mid-elevation coniferous forest occupies 69 $mi^2$ (179 $km^2$), and high elevation coniferous forest covers 23 $mi^2$ (60 $km^2$).

## METHODS

We attempted to locate, capture and color band all spotted owls within the three study areas. Spotted owls were located by night and day calling surveys using vocal imitations of spotted owls to elicit responses. Survey methods included point surveys, leap-frog road surveys, and walking cruises.

The protocols for surveying, determining social, nesting and reproductive status can be found in Verner et al. (1990). In general, we attempted to apply equal survey effort over years and study areas. Survey effort may have been influenced by inclement weather conditions,

such as high winds or steady rain, and water noise when surveying drainages.

Annual adult and subadult survival rates were calculated. Adult and subadult survival rates (S) include both males and females and include owls that may temporarily occupy a territory. Jolly-Seber (J-S) survival estimates were calculated with the J-S capture-recapture model for open populations, allowing for losses and gains to the population between sampling periods. A sampling period was defined as one field season (1 March-30 September). Assumptions of the J-S model were that all individuals in the population have equal survival and capture probabilities and emigration was permanent. Adult and subadult survival rates, as well as juvenile survival rates and fecundity, were used to estimate the population growth rate (lambda ($\lambda$)). The juvenile survival rate ($S_o$) was estimated at 0.349, the current estimate for a closed population of spotted owls in southern California (Bill LaHaye personal comm.). Fecundity (b) equals the number of female fledglings produced per female checked for reproduction. Assuming a 50/50 sex ratio of juveniles, fecundity is calculated by halving the mean number of young fledged per pair. The estimate of $\lambda$ allowed testing of the hypothesis that a population was significantly increasing ($\lambda>1$) or decreasing ($\lambda<1$). The appropriate test statistics followed a *Z*-distribution.

## RESULTS

### SURVEY

Surveys began in all study areas in the first week of March and ended on 30 September. All study areas have been subdivided into sites that can usually be completely surveyed during a work period. To achieve total coverage of the study areas we attempted to survey all unoccupied sites six times regardless of vegetation type, slope, aspect, or elevation. Sites above 8,000 ft (2,438 m) on the SNF and NS and some sites that had no previous owl detections received less than six surveys. Rain and snow during the months of March, April, and May hampered the survey effort. Wildfires in the Three Rivers area (SNP) prevented the complete coverage of some low elevation sites.

### DETECTION AND CAPTURE

On the SNF, 68 adult and subadult owls were detected (a decline of two from 1995) (Table 1a). Twenty-six pairs were found in 1996 and four juveniles were produced. Owl numbers and nesting activity were similar to the 1991 and 1995 seasons. For the seven years of the study the SNF has averaged 30.0 pairs of owls per year producing an average of 18.6 juveniles per year, or 0.62 juveniles per pair per year. In 1996, eight owls (1adult and 7 subadults, 2 males and 6 females) were captured. The 1996 adult-subadult ratio was 80/20 (Table 2a), the average for the seven years of study was 85/15. All juveniles that were found in the study area in 1996 were banded.

For SNP, the number of owls detected declined to 66 in 1996 from the 80 found in 1995. Twenty-eight pairs were detected in 1996 and three juveniles were fledged (Table 1b). The seven year average of the number of juveniles fledging per year is 15.4 from an average of 27.8 pairs of owls, or 0.55 juveniles per pair per year. The ratio of adults to subadults was higher on the SNP (93/7) than on the SNF (Table 2b). The seven year average for SNP is 89/11. In 1996 three adult and subadult owls (2 males and 1 female) were captured. All juveniles found were captured and banded.

On the NS study area, 28 owls were detected: 13 pairs, one single female, and one male (Table 1c). Two juveniles were fledged in 1996. The three year average for NS is 4.6 juveniles per year from an average of 14 pairs of owls, or 0.33 juveniles per pair per year. The

adult/subadult ratio was 96/4 (Table 2c), with the three year average of 89/11. Both juveniles that were detected were banded.

DENSITY

Densities in owls per square mile for 1996 were 0.42 on SNF, 0.51 on SNP, and 0.27 on NS (Table 3). The mean densities of owls for the seven years of study were 0.464 on SNF and 0.507 on SNP. The three year average for the NS study area was 0.317. No territorial owls were found above 8,000 feet, although 12.5% of the Sierra Forest study areas (SNF and NS combined) and 8.3% of the SNP study area are above that elevation.

MISSING OWLS, REPLACMENTS AND MOVEMENTS

Data for the SNF are reported in table 4a-4f for 1990 through 1996. In 1995-1996 there were 56 banded owls with confirmed status: 43 owls were present, 13 owls were confirmed missing, 12 were replaced and one moved to a new site within the study area. The empirical relocation rate, or the number of banded owls relocated from the previous year was 82% for 1991, 85% for 1992, 86% for 1993, 78% for 1994, 79% for 1995, and 77% for 1996. The average relocation rate for the time period of 1990-1996 was 81.2%.

Data for the NS are reported in table 5a-5b for 1994 through 1996. In 1995-1996 there were 29 banded owls of which 22 were relocated, seven were missing, and four replacements were found.

Data for the SNP are reported in table 6a-6f for 1990 through 1996. In 1995-1996 there were 65 banded owls with confirmed status: 51 owls were present, 14 were missing, seven were replaced, and four moved within the study area. The empirical relocation rate was 82% for 1991, 83% for 1992, 94% for 1993, 84% for 1994, 85% for 1995, and 79% for 1996. The average relocation rate for the time period of 1990-1996 was 84.5%.

Overall the SNF had a higher rate of missing owls (19%) than SNP (16%), with subadult males on the SNF having the highest absence rate (31%). Replacement of missing owls was higher on the SNF (85%) than on the SNP (72%), and adult owls that were missing were more likely to be replaced than subadults. Only 2% of banded adults moved from one roost/nest site to another between years, whereas 11% of subadults moved.

REPRODUCTION AND NESTING ATTEMPTS

The proportion of owl pairs nesting, the proportion checked for reproduction by July 15, the number of young fledged per pair and the average number of young fledged per successful reproductive pair for all study areas are reported in tables 7, 8, 9, and 10. Reproduction has varied substantially among years but differed little between study areas. In both the SNF and SNP the proportion of pairs fledging young was >40% in 4 years (1990, 1992, 1993, and 1994) and <40% in 3 years (1991, 1995, and 1996).

The proportion of pairs nesting varied between years, ranging from 19% to 90% in the Sierra Forest, and 8% to 89% in SNP. The mean proportion of pairs nesting was 50% (96 of 192 pairs checked) in Sierra Forest and 42% (64 of 151 pairs checked) in the SNP. The mean proportion of pairs fledging young was 38% in the Sierra Forest and 37% in the SNP. The mean number of young fledged per pair checked for reproduction was 0.719 in SNF, 0.651 in Sierra Forest, and 0.615 in SNP. The mean number of young fledged per reproductive pair was 1.69 in the Sierra Forest and 1.65 in the SNP. A total of 239 fledglings have been recorded in all study areas over the 7 years of the study, 128 in SNF, 99 in SNP, and 12 in NS. We banded 221 (93%) of these young with cohort bands; 34 (15.4%) of these have been recaptured as subadults or adults in the study areas. Sex ratio of returning juveniles was 23/11 (male/female). Three females banded as juveniles have moved between study areas, two from

the SNF to SNP and one from SNP to NS. These movements cover approximately 15 to 20 miles.

POPULATION TREND

Preliminary estimates of demographic parameters and rates of population change (lambda) have been calculated for the SNF, SNF and NS combined, and SNP (table 11). The only estimate of juvenile survival rate for our study sites comes from the returning cohort of banded juveniles (0.154) and accounts only for those juveniles that stayed in the study areas and were recaptured. Fecundity (b) equaled 0.3616 in SNF, 0.3226 in SNF and NS combined, and 0.2940 in SNP for 1990-1996.

## DISCUSSION

After 7 years of study, some similarities and contrasts between the SNF and SNP sites are beginning to emerge. Owl numbers, possibly on a short-term basis, peaked in 1994 in SNF and 1995 in SNP. In all study areas, reproductive owls were observed from 1000 to near 8000 feet in elevation, in habitats ranging from blue oak to red fir forests.

The SNP had a slightly higher density of owls than SNF. Part of this difference may result from a slightly larger percentage of high-elevation habitat in the SNF, but differences between study areas seemed to be widening, especially in 1995 and 1996.

The percentage of adults in the male population was higher in the SNP (86%) than SNF (77%). This most likely resulted from the higher number of missing males in the SNF, with most replacement birds being subadults (76% in SNF). These missing males may account for the lower estimation of adult and subadult survival rates (S) for SNF. The percentage of females missing (16%) is approximately even in all study areas, but increased in the SNF in 1994 (17%), 1995 (22%) and 1996 (32%) and may be of some consern. The drop in the percent of adults in both study areas in 1994 probably resulted from the entrance of the 1992 juveniles (a "bumper" year for owl reproduction in the SNF and NSP) into the territorial population. This 1992 cohort group were 2-year-old subadults in 1994.

Replacement of missing owls was higher in the SNF than SNP. Unbanded replacement birds accounted for 2/3 (22 of 33) of the owls banded in 1995 and 1996. Thirty-six percent of the unbanded replacements were adults. These unbanded birds were either previously undetected or they had recently moved into the study areas from outside. Similarly, some banded owls undoubtedly leave the study areas. The movement of banded birds out of the study areas negatively biases our estimate of adult and subadult survival rates.

Reproduction among the study areas was similar, with the SNF tending to have a slightly higher fecundity rate than SNP. The data indicate that spotted owls may be "pulse" breeders. When conditions are favorable, many pairs breed, but if conditions such as weather or prey base are suboptimal, then fewer pairs breed. We believe we observed a pulse breeding year in 1992, when 90% of the pairs in both study areas nested and three young per nest were observed at six sites in SNF and at five in SNP.

Our calculation of the rate of population change for the SNF (lambda = 0.93) and SNP (lambda = 0.95) suggested a decline in the owl population of 7% for SNF and 5% for SNP from 1988 to 1996. Bias in the estimation of population change can result from bias in the estimation of fecundity and of survival rates of juveniles, subadults, and adults. Our estimation of population change may be biased low because of undetected emigration of banded subadults and adults from the study areas. The extent of this bias is unknown at this time.

# LITERATURE CITED

Verner, Jared, G. N. Steger, G. P. Eberlein D. A. Leal, and T. E. Munton. 1991. Part 1: Spotted Owl home-range size and composition in the Sierra National Forest. Part 2: Demography of spotted owls in the Sierra National Forest and Sequoia/Kings Canyon National Parks. Annual Progress Report 1990. Internal Report, Pacific Southwest Forest and Range Experiment Station, Fresno, California. 9 pp.

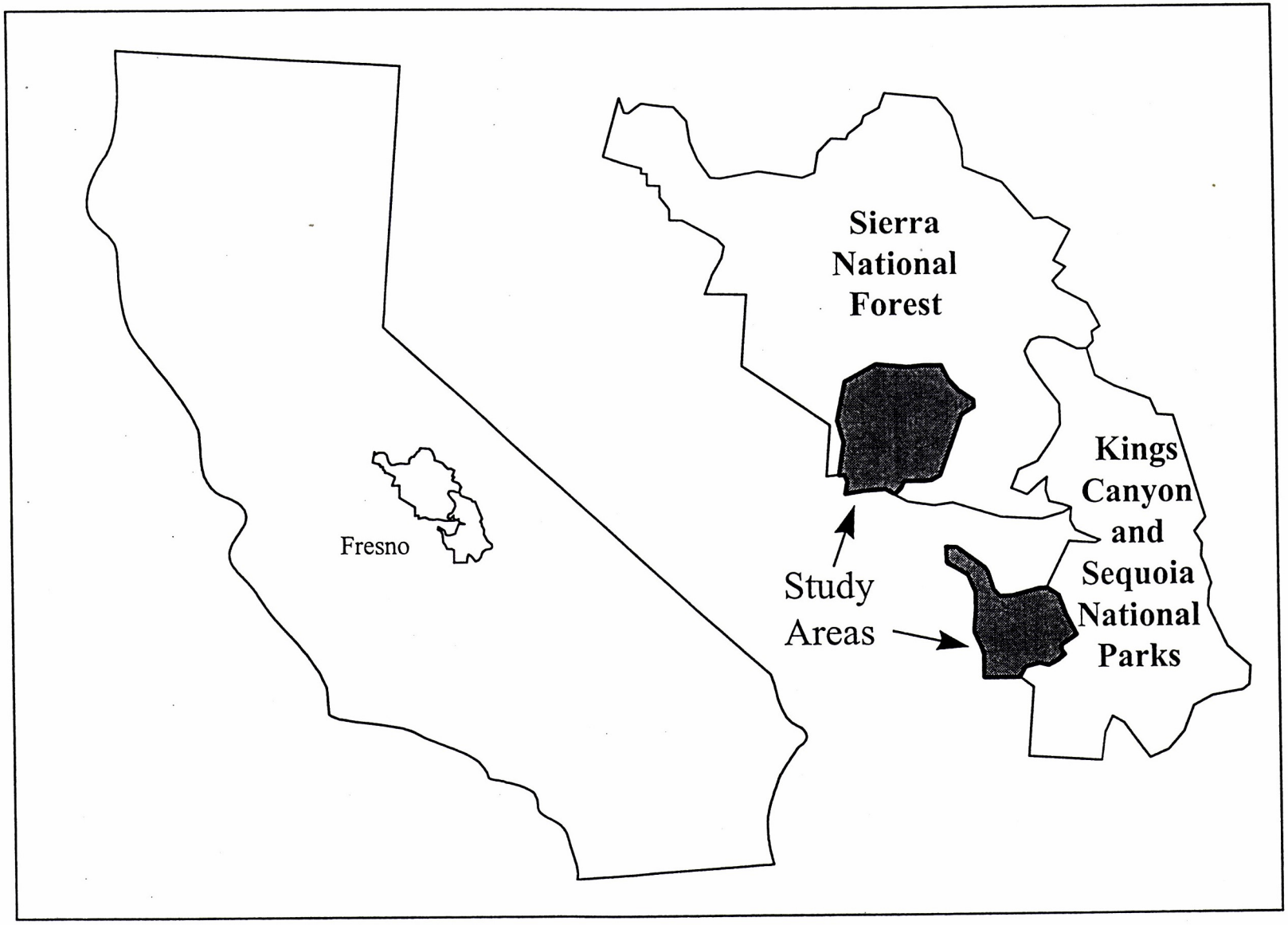


Fig. 1 California spotted owl demographic study areas in Sierra National Forest and Sequoia and Kings Canyon National Parks.

TABLE 1a. Summary of social status of adult and subadult California spotted owls on the SNF.

| SOCIAL STATUS | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Pair | 31 | 27 | 32 | 33 | 34 | 27 | 26 |
| Single male | 0 | 2 | 1 | 4 | 4 | 3 | 1 |
| Single female | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| Male & female present | 5 | 0 | 1 | 1 | 1 | 2 | 2 |
| Male present | 9 | 10 | 1 | 4 | 8 | 5 | 4 |
| Female present | 4 | 3 | 3 | 2 | 0 | 3 | 5 |
| Unknown present | | | | 1 | 2 | 0 | 1 |
| Total Number of Owls | 85 | 69 | 72 | 80 | 84 | 70 | 68 |
| Juveniles | 22 | 6 | 52 | 23 | 20 | 1 | 4 |
| Juveniles detected after July 15 | | 1 | 1 | | | | |
| Total Juveniles | 22 | 7 | 53 | 23 | 20 | 1 | 4 |

TABLE 1b. Summary of social status of adult and subadult California spotted owls on the SNP.

| SOCIAL STATUS | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Pair | 22 | 23 | 27 | 28 | 34 | 33 | 28 |
| Single male | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Single female | 0 | 1 | 0 | 0 | 0 | 1 | 2 |
| Male & female present | 2 | 5 | 0 | 2 | 0 | 2 | 0 |
| Male present | 5 | 1 | 5 | 4 | 4 | 6 | 5 |
| Female present | 1 | 0 | 0 | 2 | 2 | 2 | 0 |
| Unknown present | 0 | 2 | 1 | 1 | 0 | 1 | 3 |
| Female replaced | | | | | 1 | | |
| Total Number of Owls | 54 | 60 | 60 | 67 | 75 | 80 | 66 |
| Juveniles | 12 | 1 | 43 | 15 | 22 | 3 | 3 |
| Juveniles detected after July 15 | 9 | | | | | | |
| Total Juveniles | 21 | 1 | 43 | 15 | 22 | 3 | 3 |

TABLE 1c. Summary of social status of adult and subadult California spotted owls on the NS.

| SOCIAL STATUS | 1994 | 1995 | 1996 |
|---|---|---|---|
| Pair | 15 | 14 | 13 |
| Single male | 0 | 0 | 0 |
| Single female | 1 | 1 | 1 |
| Male & female present | 0 | 0 | 0 |
| Male present | 3 | 1 | 1 |
| Female present | 2 | 1 | 0 |
| Unknown present | 1 | 2 | 0 |
| Total Number of Owls | 37 | 33 | 28 |
| Juveniles | 9 | 1 | 2 |
| Juveniles detected after July 15 | 2 | | |
| Total Juveniles | 11 | 1 | 2 |

Table 2a. Sex and age class distribution of California spotted owls identified to age class on the SNF.

| | | 1990 | | 1991 | | 1992 | | 1993 | | 1994 | | 1995 | | 1996 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sex | Age Class | N | % | N | % | N | % | N | % | N | % | N | % | N | % |
| Male | Adult | 25 | 81 | 24 | 80 | 27 | 87 | 26 | 72 | 22 | 60 | 22 | 79 | 25 | 86 |
| | Subadult | 6 | 19 | 6 | 20 | 4 | 13 | 10 | 28 | 15 | 40 | 6 | 21 | 4 | 14 |
| | Combined | 31 | | 30 | | 31 | | 36 | | 37 | | 28 | | 29 | |
| Female | Adult | 22 | 88 | 28 | 100.0 | 30 | 97 | 30 | 91 | 28 | 85 | 26 | 90 | 22 | 73 |
| | Subadult | 3 | 12 | 0 | 0.0 | 1 | 3 | 3 | 9 | 5 | 15 | 3 | 10 | 8 | 27 |
| | Combined | 25 | | 28 | | 31 | | 33 | | 33 | | 29 | | 30 | |
| Both | Adult | 47 | 84 | 52 | 90 | 57 | 92 | 56 | 80 | 50 | 71 | 48 | 84 | 47 | 80 |
| | Subadult | 9 | 16 | 6 | 10 | 5 | 8 | 14 | 20 | 20 | 29 | 9 | 16 | 12 | 20 |
| | Combined | 56 | | 58 | | 62 | | 70 | | 70 | | 57 | | 59 | |

Table 2b. Sex and age class distribution of California spotted owls identified to age class on the SNP.

| | | 1990 | | 1991 | | 1992 | | 1993 | | 1994 | | 1995 | | 1996 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sex | Age Class | N | % | N | % | N | % | N | % | N | % | N | % | N | % |
| Male | Adult | 16 | 94 | 19 | 91 | 25 | 96 | 27 | 93 | 22 | 65 | 28 | 82 | 27 | 93 |
| | Subadult | 1 | 6 | 2 | 9 | 1 | 4 | 2 | 7 | 12 | 35 | 6 | 18 | 2 | 7 |
| | Combined | 17 | | 21 | | 26 | | 29 | | 34 | | 34 | | 29 | |
| Female | Adult | 11 | 85 | 18 | 86 | 25 | 96 | 25 | 89 | 28 | 88 | 33 | 97 | 29 | 97 |
| | Subadult | 2 | 15 | 3 | 14 | 1 | 4 | 3 | 11 | 4 | 12 | 2 | 3 | 1 | 3 |
| | Combined | 13 | | 21 | | 26 | | 28 | | 32 | | 35 | | 30 | |
| Both | Adult | 27 | 90 | 37 | 88 | 51 | 96 | 52 | 91 | 50 | 76 | 61 | 87 | 57 | 93 |
| | Subadult | 3 | 10 | 5 | 12 | 2 | 4 | 5 | 9 | 16 | 24 | 9 | 13 | 4 | 7 |
| | Combined | 30 | | 42 | | 53 | | 57 | | 66 | | 70 | | 61 | |

Table 2c. Sex and age class distribution of California spotted owls identified to age class on the NS.

| | | 1994 | | 1995 | | 1996 | | 1997 | | 1998 | | 1999 | | 2000 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sex | Age Class | N | % | N | % | N | % | N | % | N | % | N | % | N | % |
| Male | Adult | 11 | 85 | 12 | 86 | 12 | 92 | | | | | | | | |
| | Subadult | 2 | 15 | 2 | 14 | 1 | 8 | | | | | | | | |
| | Combined | 13 | | 14 | | 13 | | | | | | | | | |
| Female | Adult | 9 | 75 | 15 | 94 | 11 | 100 | | | | | | | | |
| | Subadult | 3 | 25 | 1 | 6 | 0 | 0 | | | | | | | | |
| | Combined | 12 | | 16 | | 11 | | | | | | | | | |
| Both | Adult | 20 | 80 | 27 | 90 | 23 | 96 | | | | | | | | |
| | Subadult | 5 | 20 | 3 | 10 | 1 | 4 | | | | | | | | |
| | Combined | 25 | | 30 | | 24 | | | | | | | | | |

TABLE 3.

CRUDE DENSITY

Mean crude density estimates (owls per $mi^2$) for California Spotted Owls on the SNF, SNP, and NS . Crude density was calculated by dividing the number of owls detected by the number of square miles in each study area.

| SNF (160.4 $mi^2$) | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Owls Detected | 85 | 69 | 72 | 80 | 84 | 70 | 68 |
| Crude Density $mi^2$ | 0.530 | 0.430 | 0.449 | 0.449 | 0.524 | 0.436 | 0.424 |

| SNP (130.0 $mi^2$) | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 |
|---|---|---|---|---|---|---|---|
| Owls Detected | 54 | 60 | 60 | 67 | 75 | 80 | 66 |
| Crude Density $mi^2$ | 0.415 | 0.462 | 0.462 | 0.515 | 0.577 | 0.615 | 0.508 |

| NS (103.0 $mi^2$) | 1994 | 1995 | 1996 |
|---|---|---|---|
| Owls Detected | 37 | 33 | 28 |
| Crude Density $mi^2$ | 0.359 | 0.320 | 0.272 |

TABLE 4. Relocation, missing, replacement and movement rates for only banded California spotted owls on the SNF: A 1990 to 1991, B 1991 to 1992, C 1992 to 1993, D 1993 to 1994, E 1994 to 1995, F 1995 to 1996.

**A.**

| Sex | Age Class | No Banded 1990 | RELOCATED N | RELOCATED % | MISSING N | MISSING % | REPLACED N | REPLACED % | MOVED N | MOVED % |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Adult | 15 | 12 | 80 | 3 | 20 | 4 | 27 | 1 | 7 |
| | Subadult | 5 | 3 | 60 | 2 | 40 | 2 | 40 | 0 | - |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Total | 20 | 15 | 75 | 5 | 25 | 6 | 30 | 1 | 5 |
| Female | Adult | 12 | 11 | 92 | 1 | 8 | 1 | 8 | 1 | 8 |
| | Subadult | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Total | 13 | 12 | 92 | 1 | 8 | 1 | 8 | 1 | 8 |
| Both | Adult | 27 | 27 | 23 | 4 | 15 | 5 | 19 | 2 | 7 |
| | Subadult | 6 | 6 | 4 | 2 | 33 | 2 | 33 | 0 | - |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Combined | 33 | 27 | 82 | 6 | 18 | 7 | 21 | 2 | 6 |

**B.**

| Sex | Age Class | No Banded 1991 | RELOCATED N | RELOCATED % | MISSING N | MISSING % | REPLACED N | REPLACED % | MOVED N | MOVED % |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Adult | 17 | 15 | 88 | 2 | 12 | 2 | 12 | 1 | 6 |
| | Subadult | 5 | 4 | 80 | 1 | 20 | 1 | 20 | 2 | 40 |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Total | 22 | 19 | 86 | 3 | 14 | 3 | 14 | 3 | 14 |
| Female | Adult | 19 | 16 | 84 | 3 | 16 | 3 | 16 | 2 | 11 |
| | Subadult | 0 | - | - | - | - | - | - | - | 0 |
| | Unknown | 0 | - | - | - | - | - | - | - | 0 |
| | Combined | 19 | 16 | 84 | 3 | 16 | 3 | 16 | 2 | 11 |
| Both | Adult | 36 | 31 | 86 | 5 | 14 | 5 | 14 | 3 | 8 |
| | Subadult | 5 | 4 | 80 | 1 | 20 | 1 | 20 | 2 | 40 |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Combined | 41 | 35 | 85 | 6 | 15 | 6 | 15 | 5 | 12 |

**C.**

| Sex | Age Class | No Banded 1992 | RELOCATED N | RELOCATED % | MISSING N | MISSING % | REPLACED N | REPLACED % | MOVED N | MOVED % |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Adult | 26 | 21 | 81 | 5 | 19 | 5 | 19 | 0 | - |
| | Subadult | 4 | 3 | 75 | 1 | 25 | 1 | 25 | 0 | - |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Total | 30 | 24 | 80 | 6 | 20 | 6 | 20 | 0 | - |
| Female | Adult | 26 | 24 | 92 | 2 | 8 | 2 | 8 | 0 | - |
| | Subadult | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Unknown | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Total | 28 | 26 | 93 | 2 | 7 | 2 | 7 | 0 | - |
| Both | Adult | 52 | 45 | 87 | 7 | 13 | 7 | 13 | 0 | - |
| | Subadult | 5 | 4 | 80 | 1 | 20 | 1 | 20 | 0 | - |
| | Unknown | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Combined | 58 | 50 | 86 | 8 | 14 | 8 | 14 | 0 | - |

**D.**

| Sex | Age Class | No Banded 1993 | RELOCATED N | RELOCATED % | MISSING N | MISSING % | REPLACED N | REPLACED % | MOVED N | MOVED % |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Adult | 22 | 15 | 68 | 7 | 32 | 6 | 27 | 0 | - |
| | Subadult | 7 | 5 | 71 | 2 | 29 | 1 | 14 | 1 | 4 |
| | Unknown | 2 | 2 | 100 | 0 | - | 0 | - | 0 | - |
| | Total | 31 | 22 | 71 | 9 | 29 | 7 | 23 | 1 | 3 |
| Female | Adult | 29 | 24 | 83 | 5 | 17 | 4 | 14 | 1 | 3 |
| | Subadult | 2 | 2 | 100 | 0 | - | 0 | - | 0 | - |
| | Unknown | 2 | 2 | 100 | 0 | - | 0 | - | 0 | - |
| | Combined | 33 | 28 | 85 | 5 | 15 | 4 | 12 | 1 | 3 |
| Both | Adult | 51 | 39 | 76 | 12 | 24 | 10 | 20 | 1 | 2 |
| | Subadult | 9 | 7 | 78 | 2 | 22 | 1 | 11 | 1 | 11 |
| | Unknown | 4 | 4 | 100 | 0 | - | 0 | - | 0 | - |
| | Combined | 64 | 50 | 78 | 14 | 22 | 11 | 17 | 2 | 3 |

**E.**

| Sex | Age Class | No Banded 1994 | RELOCATED N | RELOCATED % | MISSING N | MISSING % | REPLACED N | REPLACED % | MOVED N | MOVED % |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Adult | 20 | 17 | 85 | 3 | 15 | 2 | 10 | 1 | 5 |
| | Subadult | 10 | 7 | 70 | 3 | 30 | 1 | 10 | 0 | - |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Total | 30 | 24 | 80 | 6 | 20 | 3 | 10 | 1 | 3 |
| Female | Adult | 27 | 21 | 78 | 6 | 22 | 4 | 15 | 3 | 11 |
| | Subadult | 4 | 3 | 75 | 1 | 25 | 1 | 25 | 1 | 25 |
| | Unknown | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Combined | 32 | 25 | 78 | 7 | 22 | 5 | 16 | 4 | 13 |
| Both | Adult | 47 | 38 | 81 | 9 | 19 | 6 | 13 | 4 | 9 |
| | Subadult | 14 | 10 | 71 | 4 | 29 | 2 | 14 | 1 | 7 |
| | Unknown | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Combined | 62 | 49 | 79 | 13 | 21 | 8 | 13 | 5 | 8 |

F.

| Sex | Age Class | No Banded 1995 | RELOCATED N | RELOCATED % | MISSING N | MISSING % | REPLACED N | REPLACED % | MOVED N | MOVED % |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Adult | 21 | 18 | 86 | 3 | 14 | 3 | 14 | 0 | - |
| | Subadult | 3 | 2 | 67 | 1 | 33 | 0 | - | 1 | 33 |
| | Unknown | 3 | 2 | 67 | 1 | 33 | 1 | 33 | 0 | - |
| | Total | 27 | 22 | 82 | 5 | 19 | 4 | 15 | 1 | 4 |
| Female | Adult | 25 | 17 | 68 | 8 | 32 | 8 | 32 | 0 | - |
| | Subadult | 3 | 3 | 100 | 0 | - | 0 | - | 0 | - |
| | Unknown | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Total | 29 | 21 | 72 | 8 | 28 | 8 | 28 | - | - |
| Both | Adult | 46 | 35 | 76 | 11 | 24 | 11 | 24 | 0 | - |
| | Subadult | 6 | 5 | 83 | 1 | 17 | 0 | - | 1 | 17 |
| | Unknown | 4 | 3 | 75 | 1 | 25 | 1 | 25 | 0 | - |
| | Combined | 56 | 43 | 77 | 13 | 23 | 12 | 21 | 1 | 2 |

TABLE 5. Relocation, missing, replacement and movement rates for only banded California spotted owls on the NS: A 1994 to 1995 and B 1995 to 1996.

**A.**

| Sex | Age Class | No Banded 1994 | RELOCATED N | RELOCATED % | MISSING N | MISSING % | REPLACED N | REPLACED % | MOVED N | MOVED % |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Adult | 11 | 9 | 82 | 2 | 18 | 1 | 9 | 0 | - |
| | Subadult | 0 | - | - | - | - | - | - | - | - |
| | Unknown | 2 | 2 | 100 | 0 | - | 0 | - | 0 | - |
| | Total | 13 | 11 | 85 | 2 | 15 | 1 | 8 | 0 | - |
| Female | Adult | 9 | 9 | 100 | 0 | - | 0 | - | 0 | - |
| | Subadult | 3 | 3 | 100 | 0 | - | 0 | - | 0 | - |
| | Unknown | 2 | 2 | 100 | 0 | - | 0 | - | 0 | - |
| | Total | 14 | 14 | 100 | 0 | - | 0 | - | 0 | - |
| Both | Adult | 20 | 18 | 90 | 2 | 10 | 1 | 5 | 0 | - |
| | Subadult | 3 | 3 | 100 | 0 | - | 0 | - | 0 | - |
| | Unknown | 4 | 4 | 100 | 0 | - | 0 | - | 0 | - |
| | Combined | 27 | 25 | 93 | 2 | 7 | 1 | 4 | 0 | - |

**B.**

| Sex | Age Class | No Banded 1995 | RELOCATED N | RELOCATED % | MISSING N | MISSING % | REPLACED N | REPLACED % | MOVED N | MOVED % |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Adult | 12 | 9 | 75 | 3 | 25 | 3 | 25 | 1 | 8 |
| | Subadult | 2 | 1 | 50 | 1 | 50 | 0 | - | 1 | 50 |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Total | 14 | 10 | 71 | 4 | 29 | 3 | 21 | 2 | 14 |
| Female | Adult | 14 | 12 | 86 | 2 | 14 | 1 | 7 | 1 | 7 |
| | Subadult | 1 | 0 | 0 | 1 | 100 | 0 | - | 0 | - |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Total | 15 | 12 | 80 | 3 | 20 | 1 | 7 | 1 | 7 |
| Both | Adult | 26 | 21 | 81 | 5 | 19 | 4 | 15 | 2 | 8 |
| | Subadult | 3 | 1 | 33 | 2 | 67 | 0 | - | 1 | 33 |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Combined | 29 | 22 | 76 | 7 | 24 | 4 | 14 | 3 | 10 |

TABLE 6. Relocation, missing, replacement and movement rates for only banded California spotted owls on the SNP: A 1990 to 1991, B 1991 to 1992, C 1992 to 1993, D 1993 to 1994, E 1994 to 1995, F 1995 to 1996.

**A.**

| Sex | Age Class | No Banded 1990 | RELOCATED N | RELOCATED % | MISSING N | MISSING % | REPLACED N | REPLACED % | MOVED N | MOVED % |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Adult | 9 | 8 | 89 | 1 | 11 | 1 | 11 | 0 | - |
| | Subadult | 1 | 1 | 100 | 0 | - | 0 | - | 1 | 100 |
| | Unknown | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Total | 11 | 10 | 91 | 1 | 9 | 1 | 9 | 1 | 9 |
| Female | Adult | 7 | 5 | 71 | 2 | 29 | 1 | 14 | 0 | - |
| | Subadult | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Unknown | 3 | 2 | 67 | 1 | 33 | 1 | 33 | 0 | - |
| | Total | 11 | 8 | 73 | 3 | 27 | 2 | 18 | 0 | - |
| Both | Adult | 16 | 13 | 81 | 3 | 19 | 2 | 13 | 0 | - |
| | Subadult | 2 | 2 | 100 | 0 | - | 0 | - | 1 | 50 |
| | Unknown | 4 | 3 | 75 | 1 | 25 | 1 | 25 | 0 | - |
| | Combined | 22 | 18 | 82 | 4 | 18 | 3 | 14 | 1 | 5 |

**B.**

| Sex | Age Class | No Banded 1991 | RELOCATED N | RELOCATED % | MISSING N | MISSING % | REPLACED N | REPLACED % | MOVED N | MOVED % |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Adult | 11 | 8 | 73 | 3 | 27 | 2 | 18 | 0 | - |
| | Subadult | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Unknown | 3 | 3 | 100 | 0 | - | 0 | - | 0 | - |
| | Total | 15 | 12 | 80 | 3 | 20 | 2 | 13 | 0 | - |
| Female | Adult | 11 | 9 | 82 | 2 | 18 | 3 | 27 | 1 | 9 |
| | Subadult | 2 | 2 | 100 | 0 | - | 0 | - | 1 | 50 |
| | Unknown | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Total | 14 | 12 | 86 | 2 | 14 | 3 | 21 | 2 | 14 |
| Both | Adult | 22 | 17 | 77 | 5 | 23 | 5 | 23 | 1 | 5 |
| | Subadult | 3 | 3 | 100 | 0 | - | 0 | - | 1 | 33 |
| | Unknown | 4 | 4 | 100 | 0 | - | 0 | - | 0 | - |
| | Combined | 29 | 24 | 83 | 5 | 17 | 5 | 17 | 2 | 7 |

**C.**

| Sex | Age Class | No Banded 1992 | RELOCATED N | RELOCATED % | MISSING N | MISSING % | REPLACED N | REPLACED % | MOVED N | MOVED % |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Adult | 24 | 24 | 100 | 0 | - | 0 | - | 0 | - |
| | Subadult | 0 | - | - | - | - | - | - | - | - |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Total | 24 | 24 | 100 | 0 | - | 0 | - | 0 | - |
| Female | Adult | 23 | 20 | 87 | 3 | 13 | 3 | 13 | 0 | - |
| | Subadult | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Unknown | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Total | 25 | 22 | 88 | 3 | 12 | 3 | 12 | 0 | - |
| Both | Adult | 47 | 44 | 94 | 3 | 6 | 3 | 6 | 0 | - |
| | Subadult | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Unknown | 1 | 1 | 100 | 0 | - | 0 | - | 0 | - |
| | Combined | 49 | 46 | 94 | 3 | 6 | 3 | 6 | 0 | - |

**D.**

| Sex | Age Class | No Banded 1993 | RELOCATED N | RELOCATED % | MISSING N | MISSING % | REPLACED N | REPLACED % | MOVED N | MOVED % |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Adult | 26 | 20 | 77 | 6 | 23 | 5 | 19 | 0 | - |
| | Subadult | 2 | 2 | 100 | 0 | - | 0 | - | 0 | - |
| | Unknown | 1 | 1 | 100 | 0 | - | 0 | - | 1 | 100 |
| | Total | 29 | 23 | 70 | 6 | 21 | 5 | 17 | 1 | 3 |
| Female | Adult | 23 | 20 | 87 | 3 | 13 | 2 | 9 | 0 | - |
| | Subadult | 2 | 2 | 100 | 0 | - | 1 | 50 | 1 | 50 |
| | Unknown | 1 | 1 | 100 | 0 | - | 1 | 100 | 1 | 100 |
| | Total | 26 | 23 | 88 | 3 | 12 | 4 | 15 | 2 | 8 |
| Both | Adult | 49 | 40 | 82 | 9 | 18 | 7 | 14 | 0 | - |
| | Subadult | 4 | 4 | 100 | 0 | - | 1 | 25 | 1 | 25 |
| | Unknown | 2 | 2 | 100 | 0 | - | 1 | 50 | 2 | 100 |
| | Total | 55 | 46 | 84 | 9 | 16 | 9 | 16 | 3 | 5 |

**E.**

| Sex | Age Class | No Banded 1994 | RELOCATED N | RELOCATED % | MISSING N | MISSING % | REPLACED N | REPLACED % | MOVED N | MOVED % |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Adult | 20 | 17 | 85 | 3 | 15 | 3 | 15 | 0 | - |
| | Subadult | 9 | 8 | 89 | 1 | 11 | 0 | - | 0 | - |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Total | 29 | 25 | 86 | 4 | 14 | 3 | 10 | 0 | - |
| Female | Adult | 27 | 23 | 85 | 4 | 15 | 3 | 11 | 0 | - |
| | Subadult | 3 | 2 | 67 | 1 | 33 | 0 | - | 0 | - |
| | Unknown | 3 | 3 | 100 | 0 | - | 0 | - | 0 | - |
| | Total | 33 | 28 | 85 | 5 | 15 | 3 | 9 | 0 | - |
| Both | Adult | 47 | 40 | 85 | 7 | 15 | 6 | 13 | 0 | - |
| | Subadult | 12 | 10 | 83 | 2 | 17 | 0 | - | 0 | - |
| | Unknown | 3 | 3 | 100 | 0 | - | 0 | - | 0 | - |
| | Combined | 62 | 53 | 85 | 9 | 15 | 6 | 10 | 0 | - |

**F.**

| Sex | Age Class | No Banded 1995 | RELOCATED N | RELOCATED % | MISSING N | MISSING % | REPLACED N | REPLACED % | MOVED N | MOVED % |
|---|---|---|---|---|---|---|---|---|---|---|
| Male | Adult | 26 | 20 | 77 | 6 | 23 | 5 | 19 | 1 | 4 |
| | Subadult | 5 | 3 | 60 | 2 | 40 | 1 | 20 | 2 | 40 |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Total | 31 | 23 | 74 | 8 | 26 | 6 | 19 | 3 | 10 |
| Female | Adult | 33 | 27 | 82 | 6 | 18 | 1 | 3 | 1 | 3 |
| | Subadult | 2 | 1 | 50 | 1 | 50 | 0 | - | 0 | - |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Total | 35 | 28 | 80 | 7 | 20 | 1 | 3 | 1 | 3 |
| Both | Adult | 59 | 47 | 80 | 12 | 20 | 6 | 10 | 2 | 3 |
| | Subadult | 7 | 4 | 57 | 3 | 43 | 1 | 14 | 2 | 29 |
| | Unknown | 0 | - | - | - | - | - | - | - | - |
| | Combined | 66 | 51 | 77 | 15 | 23 | 7 | 11 | 4 | 6 |

TABLE 7a. Proportion of California spotted owl pairs nesting on the SNF.

| YEAR | NESTING CHECKED N | PAIRS NESTING N | PROPORTION NESTING Percent |
|---|---|---|---|
| 1990 | 8 | 5 | 0.63 |
| 1991 | 9 | 6 | 0.67 |
| 1992 | 30 | 27 | 0.90 |
| 1993 | 33 | 19 | 0.58 |
| 1994 | 33 | 19 | 0.58 |
| 1995 | 23 | 6 | 0.26 |
| 1996 | 25 | 6 | 0.24 |

TABLE 7b. Proportion of California spotted owl pairs nesting on the SNP.

| YEAR | NESTING CHECKED N | PAIRS NESTING N | PROPORTION NESTING Percent |
|---|---|---|---|
| 1990 | 5 | 4 | 0.80 |
| 1991 | 11 | 2 | 0.18 |
| 1992 | 27 | 24 | 0.89 |
| 1993 | 25 | 15 | 0.60 |
| 1994 | 27 | 16 | 0.59 |
| 1995 | 31 | 5 | 0.16 |
| 1996 | 25 | 2 | 0.08 |

TABLE 7c. Proportion of California spotted owl pairs nesting on the NS.

| YEAR | NESTING CHECKED N | PAIRS NESTING N | PROPORTION NESTING Percent |
|---|---|---|---|
| 1994 | 11 | 6 | 0.55 |
| 1995 | 9 | 1 | 0.11 |
| 1996 | 11 | 1 | 0.09 |

TABLE 8a. Proportion of pairs of California spotted owls checked for reproduction by 15 July which fledged young on the SNF.

| YEAR | Pairs Checked N | Pairs Fledging Young N | Proportion Fledging Young |
|---|---|---|---|
| 1990 | 18 | 13 | 0.72 |
| 1991 | 13 | 5 | 0.38 |
| 1992 | 30 | 26 | 0.87 |
| 1993 | 33 | 14 | 0.42 |
| 1994 | 33 | 14 | 0.42 |
| 1995 | 26 | 1 | 0.04 |
| 1996 | 25 | 3 | 0.12 |

TABLE 8b. Proportion of pairs of California spotted owls checked for reproduction by 15 July which fledged young on the SNP.

| YEAR | Pairs Checked N | Pairs Fledging Young N | Proportion Fledging Young |
|---|---|---|---|
| 1990 | 8 | 7 | 0.88 |
| 1991 | 12 | 1 | 0.08 |
| 1992 | 27 | 23 | 0.85 |
| 1993 | 25 | 11 | 0.44 |
| 1994 | 29 | 14 | 0.48 |
| 1995 | 33 | 2 | 0.06 |
| 1996 | 27 | 2 | 0.07 |

TABLE 8c. Proportion of pairs of California spotted owls checked for reproduction by 15 July which fledged young on the NS.

| YEAR | Pairs Checked N | Pairs Fledging Young N | Proportion Fledging Young |
|---|---|---|---|
| 1994 | 11 | 5 | 0.45 |
| 1995 | 14 | 1 | 0.07 |
| 1996 | 12 | 1 | 0.08 |

TABLE 9a. Mean number of young fledged per pair of California spotted owls checked for reproduction by 15 July on the SNF.

| YEAR | Pairs Checked N | Young Found N | Young Per Pair Mean |
|---|---|---|---|
| 1990 | 18 | 22 | 1.22 |
| 1991 | 13 | 6 | 0.46 |
| 1992 | 30 | 52 | 1.73 |
| 1993 | 33 | 23 | 0.70 |
| 1994 | 33 | 20 | 0.61 |
| 1995 | 26 | 1 | 0.04 |
| 1996 | 25 | 4 | 0.16 |

Table 9b. Mean number of young fledged per pair of California spotted owls checked for reproduction by 15 July on the SNP.

| YEAR | Pairs Checked N | Young Found N | Young Per Pair Mean |
|---|---|---|---|
| 1990 | 8 | 12 | 1.50 |
| 1991 | 12 | 1 | 0.08 |
| 1992 | 27 | 43 | 1.59 |
| 1993 | 25 | 15 | 0.60 |
| 1994 | 29 | 22 | 0.76 |
| 1995 | 33 | 3 | 0.09 |
| 1996 | 27 | 3 | 0.11 |

TABLE 9c. Mean number of young fledged per pair of California spotted owls checked for reproduction by 15 July on the NS.

| YEAR | Pairs Checked N | Young Found N | Young Per Pair Mean |
|---|---|---|---|
| 1994 | 11 | 9 | 0.82 |
| 1995 | 14 | 1 | 0.07 |
| 1996 | 12 | 2 | 0.17 |

TABLE 10a. Mean number of young fledged per pair of California spotted owls that fledged young on the SNF.

| YEAR | Pairs Checked N | Young Found N | Young Per Pair Mean |
|---|---|---|---|
| 1990 | 13 | 22 | 1.69 |
| 1991 | 5 | 6 | 1.20 |
| 1992 | 26 | 52 | 2.00 |
| 1993 | 14 | 23 | 1.64 |
| 1994 | 14 | 20 | 1.43 |
| 1995 | 1 | 1 | 1.00 |
| 1996 | 3 | 4 | 1.33 |

TABLE 10b. Mean number of young fledged per pair of California spotted owls that fledged young on the SNP.

| YEAR | Pairs Checked N | Young Found N | Young Per Pair Mean |
|---|---|---|---|
| 1990 | 7 | 12 | 1.71 |
| 1991 | 1 | 1 | 1.00 |
| 1992 | 23 | 43 | 1.87 |
| 1993 | 11 | 15 | 1.36 |
| 1994 | 14 | 22 | 1.57 |
| 1995 | 2 | 3 | 1.50 |
| 1996 | 2 | 3 | 1.50 |

TABLE 10c. Mean number of young fledged per pair of California spotted owls that fledged young on the NS.

| YEAR | Pairs Checked N | Young Found N | Young Per Pair Mean |
|---|---|---|---|
| 1994 | 5 | 9 | 1.80 |
| 1995 | 1 | 1 | 1.00 |
| 1996 | 1 | 2 | 2.00 |

Table 11. Estimation of demographic parameters and rate of population change for the Sierra National Forest Study Areas, combined Sierra Study Areas, and the Sequoia and Kings Canyon National Parks Study Area

| SNF | | Sierra Forest | | SNP | |
|---|---|---|---|---|---|
| 1987-1992 | | ---- | | 1988-1992 | |
| $S_o$ = | 0.349 (Est.) | | | $S_o$ = | 0.349 (Est.) |
| S = | 0.8377 | | | S = | 0.8732 |
| b = | 0.656 | | | b = | 0.4653 |
| Lambda | 1.02484 | | | Lambda | 1.01316 |
| z = | 0.56027 | | | z = | 0.29181 |
| 1987-1993 | | ---- | | 1988-1993 | |
| $S_o$ = | 0.349 (Est.) | | | $S_o$ = | 0.349 (Est.) |
| S = | 0.8433 | | | S = | 0.9072 |
| b = | 0.548 | | | b = | 0.4227 |
| Lambda | 1.00395 | | | Lambda | 1.03634 |
| z = | 0.11409 | | | z = | 1.09853 |
| 1987-1994 | | ---- | | 1988-1994 | |
| $S_o$ = | 0.349 (Est.) | | | $S_o$ = | 0.349 (Est.) |
| S = | 0.8349 | | | S = | 0.9037 |
| b = | 0.484 | | | b = | 0.413 |
| Lambda | 0.97896 | | | Lambda | 1.03006 |
| z = | 0.69547 | | | z = | 1.05136 |
| 1987-1995 | | 1987-1995 | | 1988-1995 | |
| $S_o$ = | 0.349 (Est.) | $S_o$ = | 0.349 (Est.) | $S_o$ = | 0.349 (Est.) |
| S = | 0.8295 | S = | 0.8338 | S = | 0.8631 |
| b = | 0.405 | b = | 0.3702 | b = | 0.3365 |
| **Lambda** | **0.95258** | **Lambda** | **0.94744** | Lambda | 0.96783 |
| **z =** | **1.77871** | **z =** | **2.05052** | z = | 1.19524 |
| **P =** | **0.038** | **P =** | **0.02** | P = | 0.11 |
| 1987-1996 | | 1987-1996 | | 1988-1996 | |
| $S_o$ = | 0.349 (Est.) | $S_o$ = | 0.349 (Est.) | $S_o$ = | 0.349 (Est.) |
| S = | 0.8174 | S = | 0.8257 | S = | 0.8575 |
| b = | 0.3616 | b = | 0.3226 | b = | 0.2940 |
| **Lambda** | **0.92850** | **Lambda** | **0.92608** | **Lambda** | **0.95011** |
| **z =** | **2.91207** | **z =** | **3.24961** | **z =** | **2.10198** |
| **P =** | **0.0018** | **P =** | **0.0006** | **P =** | **0.018** |